6.895 Theory of Parallel Systems	Due: Monday, September 22nd

Problems 1–3

Problem 1. (Exercise 1-3 from Minicourse on Multithreaded Programming) Prove that a greedy scheduler achieves the stronger bound:

$$T_P \leq \frac{(T_1 - T_\infty)}{P} + T_\infty\,. \tag{1}$$

Problem 2. (Exercise 1-6 from Minicourse on Multithreaded Programming) Professor Tweed takes some measurements of his (deterministic) multithreaded program, which is scheduled using a greedy scheduler, and finds that $T_4 = 80$ seconds and $T_{64} = 10$ seconds. What is the fastest that the professor's computation could possibly run on 10 processors?

Problem 3. (Different Speed Processors) In this problem we consider how to schedule on processors of different speeds. Let there be p processors $1 \ldots p$, where processor i has speed π_i steps/time. Assume that $\pi_1 \geq \pi_2 \geq \cdots \geq \pi_p$. Let W_1 represent the *total work*, that is the total number of nodes in the dag G. Let W_∞ represent the *critical path length* of the graph, that is, the number of nodes in the longest chain in G. Let π_{ave} steps/time be the *average speed* of the processors, that is, $\pi_{ave} = \sum_{i=1}^{p} \pi_i / p$. Let T_p represent the *optimal time* to execute G on p processors.

Problem 3.a. Briefly explain why an arbitrary greedy schedule may perform poorly.

Problem 3.b. Describe a good greedy scheduler for this system.

Problem 3.c. Prove an analog of Graham/Brent for your scheduler. You should be able to show that:

$$T_p \quad \leq \quad \frac{W_1}{p\,\pi_{ave}} + \left(\frac{p-1}{p}\right)\frac{W_\infty}{\pi_{ave}}\,. \tag{2}$$

Problem 3.d. Can you still show that the time to complete all tasks is within a factor of 2 of optimal? Why or why not?